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LOWER CALIFORNIA AND ITS NATURAL RESOURCES: A REVIEW*

By W. M. Davis

The Biological Survey of our Department of Agriculture, which, unlike the Geological Survey of the Interior Department, appears not to be limited to studies of our national domain, found sixteen years ago that it needed first-hand information on the peninsula of Lower California, little known in spite of the many expeditions and the numerous books and articles that had been concerned with it. Hence E. W. Nelson, chief of the Bureau, accompanied by E. A. Goldman, went in March, 1905, to make a thorough examination of that arid region. During a stay of eleven months the two experts covered a distance of over 2,000 miles in the saddle, traversing the 30- to 100-mile breadth of the peninsula eight times in different parts of its 800-mile length.

The Work as a Whole

The report on their work, lately issued after long delay, includes a narrative of the journey, a sketch of physical features, brief notes chiefly physiographic on recent geological history, and descriptions of the principal mountain ranges, plains and larger valleys, streams and water supply, islands, and climate. Then follow summaries of plant life, animal life, subordinate faunal districts, and life zones; these sections include many lists of plants and animals and represent an immense amount of high-grade biological work. A brief statement of natural resources in plant and animal life is added. The volume closes with outlines of previous explorations and an extended bibliography of some 360 reports and essays, both these subjects being brought up to 1919. The general map, compiled from many sources, printed in black outlines and hachures with a red route line, on a scale of 1:2,000,000, and measuring 29 by 22½ inches, is the best representation of the region yet published. The coast alone has been surveyed; the interior topography is sketched.

Scope of the Present Review

A great fund of trustworthy information is thus brought together in excellent form. The narrative of the journey is very readable; the physiographic descriptions are easily understood and give an informing picture of the desert peninsula as a whole; and the biological chapters may be taken as fully authoritative.

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* E. W. Nelson: Lower California and Its Natural Resources. 194 pp.; maps, ills., bibliogr., index. *Memoirs Natl. Acad. of Sci.*, Vol. 16, First Memoir, Washington, D. C., 1921. 12 x 9½ inches.

The present notice is concerned chiefly with those pages of the memoir which treat the physiographic features of Lower California, as the accounts of the flora and fauna are presented for the most part in form for botanists and zoölogists and not for geographers. The notice, moreover, is based chiefly on the middle pages of the volume (48–102), in which the leading features, as determined by observations during the long zigzag journey supplemented by the records of other travelers, are well generalized; but some items are taken from the narrative. It may be suggested that readers who, like the present reviewer, examine the memoir chiefly from a geographical point of view, will do well to turn first to the middle of the volume, so that when return is made to the preceding pages the physiographic items there described in narrative style may be understood as parts of the larger forms to which they belong; and it may be added that the narrative could be consulted with much greater ease if its dates were set up in bold-faced type in the text and were also printed on the map in red at appropriate points on the red route line.

THE MOUNTAIN RANGES: SAN PEDRO MÂRTIR

The numerous mountain ranges of the peninsula are taken to be, as a rule, larger or smaller fault blocks, moderately dissected since their slanting uplift. They nearly all have northwest-southeast trends like the peninsula as a whole, but their sides will be here spoken of as eastern and western. One of the largest ranges is the granitic mass of the Sierra San Pedro Mârtir, which with its lower terminal dependencies has a total length of over 100 miles opposite the uppermost part of the Gulf of California. Its crest, gradually rising from either end to a middle stretch 6,000 or 8,000 feet in altitude, is of simple profile, belying the name "Sierra"; its precipitous eastern face, scored by narrow, steep-walled canyons, descends 4,000 to 6,000 feet in about 5 miles from the even crest to a simple base line in an elongated intermont basin, the valley of San Felipe, shut in from the Gulf by subordinate ridges. The western slope of the range makes a relatively gradual descent to the ocean, 40 or 50 miles distant from the crest. The higher part of the western slope is of so moderate a relief that it is described as a "plateau," but in view of its persistent inclination it might be better called a slanting highland. Its surface offers much variety of form, as it is surmounted by knobs and ridges and dissected by narrow valleys. Much of the highland exhibits bare rock, bearing many large boulders presumably weathered in place. The highest summit, La Providencia Peak, over 10,000 feet in altitude, appears to result from the location of one of the surmounting ridges on the range crest, somewhat north of its mid-length; the ragged "cockscomb" of the peak is perhaps due to the local sharpening of the ridge end by the retrogressive erosion of east-face canyon heads on either side of it. A curious characteristic of the highland is the occurrence of occasional flat-floored grassy basins or parks, the origin of which is not explained. In view of the low latitude of their district (31°) and of the aridity of the region, a glacial origin seems hardly possible, in spite of the considerable altitude of the Sierra. It may be remarked that the steep east-facing escarpment of this granitic range and its simple eastern base line confirm very clearly its origin by up-faulting; and the long westward slope of its slanting highland may be taken, apart from its recently incised valleys, to represent the general character of the region before block faulting took place. This part of the peninsula must then have been a granitic lowland of moderate relief, interrupted here and there by rounded ridges and knobs and overstrewn with weathered boulders; and as a lowland it must have had less rainfall than it now enjoys since gaining its highland estate.

SIERRA JUÁREZ

The Sierra Juárez (p. 55), farther north, is another granitic range of pronouncedly unsymmetrical form, strongly scarped on the east and sloping moderately to the west, and again possessing ridges and knobs, bare rock and boulders, parks and ponds on the upper part of its slanting highland. It begins near the international border and trends almost due south for 80 miles, so as to overlap on the east the curve made by the scarp of the San Pedro Mártir range toward its northern termination; and the Sierra Juárez has a curved southeastward extension in the Sierra San Felipe and other smaller ranges, which lie to the east of the San Pedro Mártir along the Gulf coast. Block faulting with tilting to the west thus seems to be responsible for the main features of these and of many other ranges; but, if the region is ever studied in detail, it will probably be found that the large single blocks here instanced are more or less shattered where they approach each other.

THE SOUTHERN RANGES

The mountains in the southern half of the peninsula—except the terminal Sierra de la Victoria, which appears to be an east-tilted granitic block—form a nearly continuous mass 300 miles in length and 30 to 50 in width, and are described as consisting of sandstones covered by lava beds, much dissected; here a fault-block origin of the ranges is not specified. The attitude of the sandstone strata and of the lava beds is seldom if at all mentioned in the text, although a nearly horizontal attitude for the latter seems to be implied by describing their surface as making plateaus and mesas; and this is confirmed by the forms of canyon walls shown in several plates. Nevertheless, it may be inferred that the lava beds have a gentle inclination to the west, as if their eruption had been previous to the block faulting of the region. Thus a "lava-covered plateau . . . cut in all directions by deep ragged box canyons" is described as forming the "Pacific slope" of one of the largest ranges next south of the peninsula mid-length; and the lava-bed cliffs of the canyon walls are said to decrease in height down stream. Again, it is said that in a district farther south, "canyons of varying depths gash the surface of this great volcanic plain, which gradually rises [eastward] to its greatest elevation" near the range crest (p. 38). More explicit still is the account of the southern end of the southernmost lava-covered range, the Sierra de la Giganta. Its western base is a "rolling country," which increases in relief as the long ascent of the range is begun until sharp-edged mesas show that they as well as the lower rolling country "were made by the erosion of a great plateau sloping down" from the high range crest. The deep canyons within the range exhibit the underlying sandstones and the covering lava beds, which are cut off in "high cliffs" where the range falls abruptly to the Gulf coast (p. 42).

It is highly significant that here as well as at two other points farther north, Santa Rosalia and Mulege (Muleje on the map), where the coast at the eastern base of the lava-covered ranges was reached, no mention is made of volcanic rocks reaching the sea level; although, had the eruptions occurred after the uplift of the mountain blocks, occasional lava cascades down the eastern scarps—like those which plunge into the western part of the Colorado canyon—might have been expected. It is true that the journey over the southern ranges led at one time "through the broken plateau country among scattered volcanic crater cones which rise from about 300 to 1,000 feet above the general level. Each cone is the center of a series of lava beds which spread over the surrounding plain" (p. 38); and from this it might be inferred that the cones and flows were of recent origin; but the next sentence tells, as already quoted, that "canyons of varying depths gash the surface of this great volcanic plain" and thus throws the date of the eruptions so far back that they must have preceded the mountain upheaval. Post-faulting eruptions must be relatively rare. The greater volume of the lava beds appears to have shared the uplift as well as the erosion of the present mountain masses; and, if so, then this part of the peninsula must have been, in its pre-faulting stage, a desert lava plain, and must be, in its present stage, a moderately dissected fault-block mountain, like the San Pedro Mârtir range.

In any case, the Sierra de la Giganta, about 80 miles in length, with summits from 2,500 to 4,500 feet in altitude, is represented on the map as having a distinctly unsymmetrical, fault-block form, with a steep escarpment falling off in 5 or 10 miles to the Gulf shore line and a gentler slope largely lava-covered, descending for 30 or 40 miles on the west. It would be highly interesting from a physiographic point of view to learn whether this southernmost lava-covered range may not be a homologue of the lava-covered Natanes ranges in western New Mexico, long ago incompletely described and explained by Gilbert in his first season of western work, and of the similar Humboldt ranges of Nevada described thirty years later and convincingly explained as tilted fault blocks by Louderback. If any future explorer attempt to solve this problem it would be well for him to examine not only the main Sierra but also the small islands in the Gulf a little east of the Sierra escarpment; for, according to the fault-block theory, these islands should be little-lifted chips of the great mainland block, and as such they should show the lava beds on the sandstones at a relatively low level.

INTERMONT BASINS

A number of elongated intermont basins occupy the depressions between the ranges in the northern half of the peninsula and are as manifestly aggraded depressions as the ranges are dissected uplifts. The basin of San Felipe, above-mentioned as lying beneath the great escarpment of the Sierra San Pedro Mârtir, is one of the largest examples; it is about 70 miles in length and 10 or 15 in width. Great alluvial fans slope into it from the canyons in the high escarpment: they are strewn for a mile or more from their apex with boulders up to 6 or 8 feet in diameter, which testify to the enormous force of occasional floods. Small streams in the canyons, following the nymph-like habit of streams in desert mountains elsewhere, advance a short distance out upon the fans in the cool hours of the night and may be still found there in the early hours of the next morning; but during the heat of the glaring day they retreat a mile or more into their rocky fastnesses. No mention is made of any recent fault scarps across the fans near the base of the great escarpment, as indicative of a recent renewal of up-faulting, nor of the termination of the inter-canyon spurs in steep triangular facets, indicative of the inclined fault plane on which the enormous displacement of the mountain block originally took place. As such features are associated with certain fault-block ranges in the Great Basin of Utah and Nevada, they may possibly be found here also, and, although of little importance biologically, they are of much interest physiographically.

RATE OF GEOLOGIC CHANGE

The weathered boulders on the mountains and the washed boulders on the fans are taken to prove that geological changes in this arid region are progressing actively. Thus an account of the Sierra Juárez describes its summit highlands as "a rolling mesa . . . with low, usually bare, granite ridges and gigantic piles of huge rounded rocks. These rocks were often too huge and smoothly rounded to be climbed by a man. They were evidently the results of rapid decomposition of the granite" (p. 15). Again it is said that "everywhere among the granite mountains the disintegration is very rapid, as evidenced by the vast sloping accumulations of sand, gravel, and boulders" (pp. 50, 51; also 54). It may be questioned whether this inference is correct. The results of weathering and the work of transportation are truly very manifest, yet the weathering may be exceedingly slow, and the transportation is so long interrupted between its spasms of activity after cloud-bursts that its average rate may be deliberate. Until the time that these processes have been in operation is known, as well as the quantity of work that they have done in that time, their rate cannot be well determined; and in the meanwhile the average rate may be better regarded as leisurely than rapid.

THE OPEN PLAINS OF THE WEST

Besides the well-enclosed intermont basin plains there are several open plains on the western side of the peninsula which in part reach the ocean. The largest of these are the plains of the Vizcaino desert at the peninsula mid-length and, farther south, those of Magdalena, which stretch along the western base of the Sierra de la Giganta and wrap around its southern end in a low isthmus, thus tying the former island of the Sierra de la Victoria to the mainland. The Vizcaino plain occupies a triangular depression, about 80 miles on a side, open to the northwest. At its northeastern angle the plain enters a constriction between the northern granitic ranges and the southern lava-covered ranges. The southwestern side of the triangle is limited by the outstanding Sierra Vizcaino, "mainly volcanic", which is continued northwestward into the ocean, thus forming the curious horn by which the Pacific side of the peninsula is characterized; the horn is extended by several islands. The broad plain in the depression thus enclosed appears to have been aggraded chiefly by detritus from the larger mountain ranges of the peninsular axis, as its surface rises inland towards them and reaches an altitude of 1,200 feet at their base. The open side of the plain, between the Vizcaino horn and the northern ranges, has a curved re-entrant shore line, presumably determined by the sweep of the ocean waves and currents; the re-entrant is occupied by Sebastian Vizcaino Bay. The Sierra Vizcaino approaches the lava-covered ranges at the southern angle of the triangular plain, but the plain continues through the gap and beyond in a narrowing southward extension for 70 miles; here it again has a curved re-entrant shore line bordered by sand reefs and fronted by Ballenas Bay. Unfilled lagoons of moderate area occur behind each of the re-entrant shore lines, thus indicating that the triangular depression is not yet so well filled as it may come to be in the future. The exceptionally great breadth already attained by the plain is evidently due to the protection afforded by the outstanding Sierra Vizcaino, formerly an island, against the waves of the Pacific.

The Magdalena plain, about 180 miles in length and 40 in greatest width, is similarly conditioned, although the outstanding island ridges that protect its middle and most advanced part from abrasion are much smaller than the Sierra Viczaino, and although the plain behind them has less completely filled the enclosed waters. North and south of the protecting islands the narrowing plain is fronted by sand reefs and beaches which stretch in long sweeping curves concave to the ocean until they become tangent to the mainland, thus repeating the corresponding features of the Vizcaino plain. The much smaller plain of San Quintín, west of the San Pedro Mártir range in the northern part of the peninsula, shows similar features. The similarly small plain of San Bruno fronts the Gulf coast at the base of a re-entrant in the steep scarp where the northern segment of the lava-covered ranges descends to sea level; the middle of its front is protected as in the other examples by an offshore island. A little farther south the longitudinal depression behind two larger islands is shown on the map to be occupied by a plain for the southern half of its 60-mile length; its unfilled northern half holds Concepción Bay.

SHORE LINE CHANGES

In view of these detrital plains, and of certain other features, Nelson concluded that formerly "the peninsula was partly submerged and then arose slowly with approximately the outline it possesses today but considerably greater in extent. Since then it appears to have been steadily reduced through erosion by the sea" (p. 53). This conclusion does not seem well assured. There is no question that the sea has done some work in cutting back the rocky salients of the coast, as is clearly shown by the abundant sea cliffs; nor that much gravel and sand have been swept by the waves and currents along the concave beach lines of the open plains. But emerged shore lines backed by abandoned sea bluffs or cliffs are not mentioned in the text or shown in the few views of the coast; and in their absence a recent elevation of the peninsula as a whole seems improbable, to say the least. The only features which may possibly represent emerged shore bluffs are two 50-foot scarps, apparently trending north and south, which are briefly mentioned as interrupting the gradual inland ascent of the Vizcaino plain in its northern part; one is 3 miles from the shore, the other is 26 miles farther inland. The text gives no hint of their origin. As similar bluffs were not found on other parts of the Vizcaino plain, or on any part of the 100-mile traverse of the Magdalena plain, the 50-foot bluffs above mentioned may be recent fault scarps. Hence, instead of inferring that the last change of level has been a general elevation of the whole peninsula, it seems more plausible to suppose that the chief recent movements in the region have been local and diverse emergences and submergences associated with block faulting. Indeed, some of the emergences may have been followed by later submergences, also relatively local; for the Gulf coast of the southern half of the peninsula exhibits irregularities of outline that suggest a recent drowning of moderate amount, after the scarps and slopes of the displaced fault blocks that form the mainland ranges and a number of small neighboring islands had been significantly dissected.

As to the inferred steady reduction of land area through erosion by the sea since the supposed elevation of the peninsula, the rocky headlands have, as above noted, evidently enough been somewhat cut back, but the moderate height of the resulting cliffs does not indicate a great recession of the shore line. Indeed, any cliffs that have been cut at the base of the long western slope of the San Pedro Mártir mountain block where it descends to the Pacific shore and is openly exposed to attack by ocean waves, are not so high as to excite especial remark in the narrative of the days spent on that part of the coast; the actual shore line there lies for a considerable distance on a belt of beach dunes which enclose a narrow salt marsh or coastwise plain outside of "the low rolling foothill plateau" (p. 24). Indeed, along many other stretches of the coast also the land has gained on the sea by the formation of detrital plains, not only the greater ones described above, but many smaller ones also. Thus the steep eastern slope of the Sierra de la Giganta is fronted, in the southern part of its length at least, by "a sandy coast plain 2 or 3 miles broad" (p. 42). Further evidence of small recession of the shore line by wave cutting is found in the rapid descent of the sea bottom from the shore into deep water around the headlands; for example around the southern termination of the peninsula near Cape San Lucas, as shown on Hydrographic Office chart 1664; and around the western headlands of the Sierra Vizcaino, as shown on charts 1268 and 1310. On the whole it would seem that the gain resulting from the addition of detrital plains may be measured in miles, while the loss by cliff cutting should be reckoned only in furlongs.

CLIMATE: ARIDITY OF THE PENINSULA

Space does not permit an adequate continuation of this notice through the chapters on climate, flora, and fauna; but a few extracts from them may serve to illustrate the rich fund of interesting material that they contain. Aridity is the leading feature of the climate, in spite of the peninsular pattern of the land between a great ocean and a large gulf. Nelson calls attention to this fact and wisely adds that the production of artificial sheets of water, like the Salton Sea near the lower Colorado—to which may be added the proposed flooding of the "shotts" in the northern Sahara and the construction of lakes near the border of the Kalahari—with the object of modifying the climate of the adjoining deserts, must be fruitless. It is not so much an increased water surface for evaporation that is needed in such regions as an alteration in the régime of the winds, whereby they may be provoked to precipitate the moisture that they already possess; and that is beyond man's power—at present.

The scarcity of water throughout Lower California is such that even the plunge pools cut in the mountain-slope canyons below the cascades of temporary wet-weather streams are prized as drinking stations, though some of them are so inaccessible between close-set canyon walls that water can be drawn from them only by rope and bucket. The stream courses across the detrital plains are usually dry—they would be called wadis in northern Africa; but water can often be found by digging beneath them, especially in the lower part of the plains near the coast. Rain is, however, more frequently reported in Nelson's narrative than the reputation of the peninsula as a nearly rainless region would lead one to expect; and the few inhabitants have many stories of cloud-bursts and destructive floods. Thus in the northern section of the lava-covered ranges a rain in October, 1911, caused a flood which swept down a canyon with a front wall of water from 12 to 15 feet high, drowning 23 persons, destroying 39 buildings, and causing much other damage; hence the rule that death by drowning is a characteristic though not common accident in desert regions is well supported. Floods sometimes inundate the lower parts of the detrital plains: in December, 1905, Nelson's party traveled on the Magdalena plain "for nearly two days through broad shallow ponds and many swiftly flowing streams in the washes. . . . It was a curious sight to see miles of giant cactuses and other characteristic desert plants standing in the midst of broad half-submerged expanses" (p. 100).

The latent fertility of the plains is strikingly illustrated by the effects of passing showers, the course of which is marked for several following weeks by belts of verdure across the barren desert. On the small plain of San Bruno, above-mentioned as occupying an island-protected re-entrant of the Gulf coast, the travelers saw in October "a belt of green a few hundred yards wide, like a broad ribbon across the brown plain, showing where a heavy shower had passed over the country some weeks before and wet the ground sufficiently to bring up the grass and other herbage" (p. 35); and again in November on the northern part of the Magdalena plain the party "crossed a broad belt of country in which there was a good fresh growth of grasses and other herbaceous vegetation, 4 to 6 inches high, most of which was ripening its seeds. Some ranchmen . . . told us that a heavy rain fell here on August 7, which resulted in this growth. Just before nightfall we suddenly passed the border of this belt of green into the brown arid desert again and in order to give our stock the advantage of the fine pasturage were obliged to turn back and re-enter the green belt" (p. 39).

VEGETATION

A description of the desert vegetation of arid mountains and plains in geographical, not botanical, terms is a difficult art, not yet well developed. Repetition of the generic names of the innumerable cactuses—Echinocactus, Lemaireocereus, Mamillaria, Pereskiopsis, Wilcoxia, and the like—however instructive to botanists, does not furnish a geographical picture of the peculiar Lower California flora, so unfamiliar to residents of temperate and well watered regions. The creation of such a picture is truly difficult. The open-growth patches of small-tree pine forests on the slanting rocky highlands of the block mountains, above mentioned, may be easily conceived; but it is quite otherwise with the wide-spaced growth of the cirio, a remarkable tree, 20 to 50 feet high, peculiar to Lower California and constituting the prevailing species for hundreds of square miles on the granitic highlands; "the tapering yellowish trunk and rootlet-like branches give the cirio a close resemblance to a gigantic slender parsnip bottom side up" (p. 106 and Pl. 29). Similarly, the plant monstrosity known as the elephant wood contributes an utterly strange aspect to the landscape; it "has a short thick trunk and contorted branches covered with a smooth, skinlike bark which lies in thickened folds and creases, giving the tree a dropsical appearance" (p. 106 and Pl. 28).

A good instance of the utility of translation from botanical into geographical phrasing is afforded by the description of a peculiar cactus occurring on the Magdalena plain. Here a single locality was found to be occupied by an extraordinary thick-stemmed creeping cactus with upcurved ends: "these curious plants radiate from a central point, and while the parent stem dies the continual growth at the front end causes the separate stems actually to travel away from the starting point" (Pl. 14, opp. p. 40). This can be fairly well conceived by geographers, and, although the impassable cactus patch is of small area, it deserves mention along with many other small items, such as a little mud volcano on the delta of the Colorado River at the head of the Gulf, a salt bed on the eastern side of the Vizcaino desert plain (both these items are shown on Pl. 21, opp. p. 52), and a sea-turtle corral on the shores of a lagoon near the northern border of the Vizcaino plain, from which 1,000 turtles are shipped monthly to San Diego (Pl. 12, opp. p. 33).

Animal Life

Description of the animal life of the peninsula like that of the vegetation needs translation from biological into geographical phrasing. The whales, seals, and sea otters, formerly abundant on the coast, may now be lightly passed over as they have been nearly killed off. The numerous small rodents of the detrital plains, being largely of nocturnal habit, contribute little if anything to the landscape. The mountain lions, wildcats, antelope, deer, mountain sheep, coyotes, badgers, and foxes are easily listed; but the listing gives little indication of the share that these residents add to the outdoor picture of mountains and plains. It may be noted, however, that the share added by the antelope and the mountain sheep is a vanishing one, for they are on the way to extinction by hunters, such being the unhappy effects of upsetting the "natural balance of powers" by the advent of civilized man. "The mountain sheep is still widely distributed on the main mountains of the eastern half of the peninsula but, in addition to being hunted for sport, is being slaughtered without regard to age or sex to supply mining camps and small towns with meat" (p. 110).

The great variation in the annual rainfall, characteristic of arid regions, causes a corresponding variation in the abundance of various forms of animal as well as of plant life. "During series of consecutive heavy rains the desert vegetation flourishes exceedingly, great quantities of seeds are ripened, tender vegetation abounds, and desert mammals, especially the small [rodents] . . . increase enormously until favorable areas swarm with them. When the long rainless period follows, the herbage ceases to grow, no seeds are ripened, and there is a resulting scarcity of food, and an enormous mortality among the small inhabitants of the desert" (p. 111). The active but short-lived growth in certain elements of the fauna after a rain recalls the belts of verdure that for a short time mark the tracks of heavy showers on the detrital deserts. An earlier explorer, Eisen, is quoted on this point. After the first summer rains in the southern part of the peninsula, "nine-tenths of all chrysalises and larvae hatch at once, and the whole country is teeming with animal life. The bushes and trees cover themselves with leaves and flowers, giving ample food for caterpillars and insects of all kinds. . . . A week after the first rain the fauna is at its height . . . Countless lizards dart among the rocks on the hillsides or in the branches of the trees. . . . Myriads of butterflies are seen filling the air in the daytime . . . When at such a time a cloud over the sun caused a temporary shadow the innumerable host of butterflies suddenly vanished, having taken refuge on the underside of the leaves of trees, bushes, and herbs" (p. 113). Vivid descriptions of this kind make an excellent picture; and, if preceded by a correspondingly vivid account of the land forms, they enable the reader to form a mental reproduction of the region concerned that is truly geographical.

THE HUMAN ELEMENT

As to the human elements in the geography of Lower California, an aboriginal phase and some modern phases may be briefly touched upon. The native tribes, although of a very primitive order and not practicing agriculture when first known, appear to have become about as well adapted to their arid surroundings as have the desert plants. They probably had their periods of increase and decrease as determined by periods of varying rainfall; but since the coming of invaders of European stock their numbers have continually decreased from an original total estimated at 25,000 to a mere handful; only a few hundred survivors now remain. Their original condition was probably a delicate balance between savagery and aridity; when the balance was disturbed by invaders the aridity conquered and the savages dwindled away. There is no great satisfaction in that story. Nor is satisfaction found, after passing over the Spanish-Mexican colonization period, in the account of certain modern schemes to people the empty detrital plains with civilized farmers. A part of the Magdalena plain "was once the site of a disastrous attempt to establish an American colony and met the fate certain to overtake any ill-judged effort to settle this region without the proper preliminary work" of constructing storage reservoirs in the mountains and digging wells and cutting canals on the plains. Nelson remarks: "The large number of ruined and abandoned missions and ranches seen along our route was a strong warning against inconsiderate settlement of such areas" (p. 138).

Mining has been successful occasionally, moderately, locally, and temporarily, as centuries count time; but who shall count its failures! While successful its feverish activity here and there makes small interruptions in the great expanses of desert solitude and silence; and its extravagant destruction of mountain sheep, as told above, is an incongruous element in the division of economic geography, where mining, geographically considered, belongs.

Cattle raising has its ups and downs; its best success is on the western slopes of the northern mountains; it has been much less successful on the southern plains, where large herds have been developed during a succession of favorable years only to be lost in a following dry period: thus large ruminants, artificially introduced, do not escape the unhappy fate of the little indigenous rodents. It cannot be a pleasing adventure that ends in the death of thousands of creatures from starvation and thirst.

Successful human endeavor in a region of this kind evidently demands a close knowledge of the country and its climate and a careful adjustment to their demands. Such adjustment may lead, in well chosen localities, to a fair livelihood for small groups of not over-exacting persons, persons who are capable of living frugally and patiently, of persevering through difficulties and persisting against discouragements; but it is not to be supposed that all inhabitants of the peninsula possess those fine qualities. Small ventures supported by locally represented capital would appear to lead to better results than larger ventures financed at a distance. Some new settlers might be content to raise goats on offshore islands and sell their skins if not their meat; others should be satisfied with gathering wax from wild bees' nests and increasing the export of this article above the 7,000 kilograms reported in 1918. Those inclined to agriculture might try raising sugar cane on irrigated piedmont fields and selling crates of brown sugar for shipment across the Gulf to Mazatlán; but the most discriminating would probably elect to raise subtropical fruits in the valleys of the Sierra de la Victoria at the extremity of the peninsula, where the climate is said to be the finest of its kind: but in spite of these attractive little opportunities, Lower California will probably long remain a better field for the explorer than for the settler.

It should be understood that the preceding pages are concerned only with a side issue of Nelson's investigation. He went to Lower California to study the distribution of birds and mammal life and its environmental relations; and the results of these studies are concisely and technically stated, largely as lists of generic and specific names, in the later pages of his volume. Those lists and the lessons that they teach will doubtless be reviewed in appropriate biological journals. What has been set forth here is simply a selection of striking and characteristic passages, chiefly involving geographical descriptions, which, although related to the main object of study as constituting the inorganic environment of the bird and mammal fauna, are nevertheless subordinate to it. Surely this is a rich memoir, if its subordinate results are so interesting and instructive.